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# MANAGING the DAIRY HERD for Greater Returns . . . .

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## Contents



## DAIRYING Ranks FIRST in Minnesota Agriculture

DAIRY products are the most important single source of farm income in Minnesota. Some milk cows are kept on nearly all farms and on a large proportion of these farms they represent a major source of income.

In 1939, the United States Census reported the sale of dairy products from 82 per cent of all farms in the state. During the last 20 years more than 25 per cent of the gross cash income of farmers has been received from the sale of milk and cream.

In 1941, Minnesota farmers received $114,800,000 from the sale of dairy products, or 24.5 per cent of the total gross cash income ($467,700,000) obtained from 18 principal agricultural commodities.

The following table shows dairy product sales in Minnesota for 1910 to 1941. In addition to the income from the sale of dairy products, considerable income was secured from the sale of dairy cattle.

**Gross Cash Income from 18 Principal Farm Commodities in Minnesota, 1910-1941***

| Year | Income from 18 commodities† | Income from dairy products | Per cent dairy products is of total (value) income |
|---|---|---|---|
| | Million dollars | Million dollars | |
| 1910-14 average | 180.4 | 37.9 | 21.0 |
| 1915-19 | 330.4 | 59.1 | 17.9 |
| 1920-24 | 313.0 | 79.4 | 25.4 |
| 1925-29 | 408.1 | 111.9 | 27.4 |
| 1930-34 | 232.3 | 71.6 | 30.8 |
| 1935-39 | 310.9 | 86.1 | 27.7 |
| 1940 | 361.3 | 91.4 | 25.3 |
| 1941 | 467.7 | 114.8 | 24.5 |

* Cox, R. W., Waite, W. C., and Garver, W. B., Income and Expenditures of Minnesota Agriculture, Minnesota Agricultural Experiment Station Bulletin 366, page 9. 1943.

† Includes hogs, cattle, calves, lambs and sheep, chickens, turkeys, eggs, milk, butterfat, wool, wheat, corn, oats, barley, rye, flax, hay, and potatoes.


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# Managing the Dairy Herd for Greater Returns[1]

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## Introduction

### Purpose of the Study

EVERY study of farmers' records reveals a wide variation in the returns secured from dairying among similar farms in the same area. Differences as high as $75 per cow in the return over feed cost (hereinafter referred to as "return over feed") among neighboring farms are not unusual. Even in the most favorable years some farmers receive too little income from their dairy herds to cover all the costs. Other dairymen, even in years of relatively unfavorable prices, seem able to make some profit or at least to avoid losses. It is the purpose of this study to analyze the dairy cattle enterprise on a group of farms to determine the major factors and the practices which account for these large variations in financial returns. This analysis should enable farmers who are attempting to improve their dairy enterprise to determine which methods and practices have proved most profitable in this area. Much information on the effect of feeding and management methods on dairy production is already available from experimental studies in dairy husbandry. The main purpose of this study is to bring out the effect of these practices on the financial returns from the dairy herd under farm conditions and to point out how farm accounts may be used by farmers to check on their own proficiency and to determine the possibilities for increasing the dairy profits.

### Source of Data

The data used in this study were obtained from the records of the Southeast Minnesota Farm Management Service. This service is conducted cooperatively by the Division of Agricultural Economics and the Division of Agricultural Extension, Department of Agriculture, University of Minnesota, and the Bureau of Agricultural Economics of the U. S. Department of Agriculture. An average of 146 records per year were obtained from 10 counties for the years 1928 to 1937. The number of yearly records included in this study, by counties, is as follows: Dakota 11, Dodge 193, Freeborn 245, Goodhue 256, Le Sueur 56, Mower 45, Olmsted 32, Rice 205, Steele 240, Waseca 179, total 1,462. There was some change in farms from year to year. In this study each yearly record has been treated as a separate case and for brevity's sake is referred to throughout the text as "farm" or "herd."

Each farmer cooperating in this service was supplied with a Minnesota

[1] The authors wish to express their appreciation to the members of the Southeast Minnesota Farm Management Service for their cooperation in supplying the data during the 10 years of the study and to the fieldmen—R. C. Bevan, O. R. Shelley, and Glen Myers—who assisted and supervised the farmer cooperators in keeping their farm records. The authors are especially indebted to W. P. Ranney, formerly of the University of Minnesota, who participated in the summarization of the annual reports and in the preparation of the material for analyses. They also wish to express their appreciation to C. W. Crickman of the Bureau of Agricultural Economics, U. S. Department of Agriculture, for his aid in planning the study and the tabulations and to S. A. Engene of the University of Minnesota for his valuable criticisms in the preparation of the manuscript. Completion of this study was made possible by workers supplied by Work Projects Administration, Official Project No. 65-1-71-140, Subproject 468, Sponsor: University of Minnesota.

Farm Account Book in which he entered the entire farm inventory at the beginning and end of the year, cash receipts and expenses, crop yields, the quantities of feed used by the various classes of livestock, and a record of the farm produce used by the farm family. A fieldman visited the farm approximately four times during the year to check the farm record for completeness and accuracy and to secure supplementary data concerning livestock and crop practices. At the end of each year the records were summarized and preliminary reports prepared by the Division of Agricultural Economics.

## Description of Farms

Dairying was the most important single enterprise on the farms studied; hogs and poultry were raised on nearly all the farms and were second and third respectively as sources of income.[2] Sheep were kept on some of the farms and beef cattle on a few. An indication of the size and importance of the dairy enterprise is the proportion of the total work units expended on dairy cattle. A work unit, as used in this study, is the average accomplishment of a farm worker in a 10-hour day, working on crops and productive livestock at average efficiency, or 10 hours of work off the farm for pay. Approximately one half of the work units on these farms were cattle units, 16 per cent other livestock units, 28 per cent crop units, and 6 per cent represented other productive work. Since a large proportion of the crops raised were fed to livestock, the work units on crops were largely indirect contributions to livestock production.

Approximately 45 per cent of the total cash receipts was from the sale of dairy products and cattle, other livestock enterprises furnishing 35 per cent. Receipts from the sale of crops were of minor importance. Most of the crops were fed to livestock and considerable additional feed was purchased.

Most of the milk cows on the farms studied were of dairy breeding; less than 20 per cent of the farmers raised cattle of Shorthorn or other dual-purpose breeding. The majority of the dual-purpose herds were maintained primarily for butterfat production. The better heifer calves were kept for replacements and the balance were generally sold as veal. A few farmers with purebred herds sold breeding stock. A large proportion of the sires and many of the cows were purebred.

Approximately 90 per cent of the farmers sold cream for manufacture into butter; 10 per cent sold 80 per cent or more of the dairy products as whole milk or cream at retail or as whole milk to cheese factories. When cream was sold, the milk was separated on the farm and the skim milk retained as feed for livestock.

Most of the farmers included in this study were men of more than average managerial ability and, in general, were on farms larger and more productive than the average of the area. There was a wide variation in the methods and practices followed by these men. It seems reasonable to assume that similar variations occur among all farmers in the area and that any conclusions drawn from this study apply equally well to other farmers.

## Measure of Returns from Dairy Cows

The measure of efficiency or of returns from dairy cows used in this study is the return over feed, that is, the value of the butterfat and skim milk less the feed cost. The total value of the product per cow was calculated

[2] For a description of the area, see Engene, S. A., and Pond, G. A., Agricultural Production and Types of Farming in Minnesota, Minnesota Agricultural Experiment Station Bulletin 347, May 1940. Also Pond, G. A., Ranney, W. P., and Crickman, C. W., Factors Causing Variations in Earnings Among Dairy Farmers in Southeastern Minnesota, Minnesota Agricultural Experiment Station Bulletin 314, December 1934.

Table 1. Average Price of Feed on Farms in Southeastern Minnesota, 1928-1937

| Items | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 10-yr. average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alfalfa hay, ton | $15.00 | $14.50 | $13.00 | $13.00 | $10.00 | $7.50 | $12.00 | $13.00 | $8.00 | $11.00 | $11.70 |
| Clover hay, ton | 13.00 | 12.00 | 11.00 | 11.00 | 8.50 | 6.50 | 10.00 | 10.50 | 6.65 | 9.25 | 9.85 |
| Timothy hay, ton | 10.60 | 9.00 | 7.00 | 7.00 | 5.00 | 4.15 | 7.50 | 8.25 | 4.65 | 6.40 | 6.95 |
| Wild hay, ton | 8.60 | 7.50 | 6.00 | 6.00 | 4.00 | 3.25 | 6.50 | 7.50 | 4.00 | 5.50 | 5.90 |
| Corn fodder, ton | 8.00 | 7.50 | 8.00 | 7.00 | 4.00 | 3.10 | 4.75 | 4.10 | 2.50 | 3.60 | 5.25 |
| Corn silage, ton | 4.00 | 4.00 | 4.00 | 4.00 | 3.00 | 2.60 | 3.40 | 3.50 | 2.70 | 2.75 | 3.40 |
| Ear corn, bu. | .66 | .68 | .59 | .41 | .31 | .24 | .48 | .60 | .68 | .78 | .54 |
| Oats, bu. | .49 | .40 | .31 | .24 | .19 | .19 | .36 | .32 | .30 | .34 | .31 |
| Barley, bu. | .67 | .52 | .41 | .37 | .30 | .34 | .65 | .58 | .60 | .60 | .50 |
| Bran, cwt. | 1.80 | 1.60 | 1.40 | .90 | .70 | .75 | 1.15 | 1.20 | 1.30 | 1.45 | 1.20 |
| Linseed oil meal, cwt. | 2.90 | 3.05 | 2.70 | 1.85 | 1.50 | 1.60 | 2.10 | 1.90 | 2.10 | 2.10 | 2.20 |
| Skim milk, cwt. | .25 | .25 | .25 | .15 | .10 | .10 | .15 | .15 | .17 | .15 | .17 |
| Pasture, per month per animal unit | 1.25 | 1.25 | 1.25 | 1.00 | .75 | .75 | .75 | 1.00 | 1.00 | 1.00 | 1.00 |

by multiplying the pounds of butterfat produced by the average price per pound received for butterfat sold by these farmers during the 10-year period 1928 to 1937 and adding to this the estimated value of the skim milk. The average price received per pound of butterfat sold to creameries was 35.3 cents. The average value of skim milk for feeding was 17 cents per 100 pounds. The average fat test of milk was 3.7 per cent and the fat test of cream 30 per cent. The value of skim milk per pound of butterfat was 4 cents, making a combined value for skim milk and fat of 39.3 cents per pound of fat. The butterfat produced included, in addition to the sales, the butterfat in cream and milk used in the house and fed to calves.

All of the farm-raised feeds as well as the more common commercial feeds were valued at average prices on the farm (see table 1). The pasture charge was based on the usual rental rates for the community.

The average number of cows in the milking herd included all cows on the farm whether milking or dry and was determined for each year by adding the number on hand at the beginning and end of each month and dividing this total by 24. The total return over feed for the herd was divided by the average number of cows in the herd to secure the return over feed per cow.

# Factors Causing Variations in Dairy Cow Returns

## Size of Herd, Feed Cost, and Return per Cow

THE variations from year to year in size of herd, production, and feeds consumed per cow are shown in table 2. Sixty-eight per cent of farms[3] had from 9 to 21 cows per herd, 9 per cent had less than 9 cows, and 23 per cent had over 21 cows per herd. In general, the production per cow and the quantity of feed consumed per cow did not vary greatly from year to year except as they reflect somewhat the variations in crop yields of the previous year and the relative price of purchased feeds.

[3] As explained in the introduction, the term "farm" as used in this bulletin usually refers to a yearly farm record, that is, one farm for one year. Thus the "1,462 farms" frequently mentioned is the cumulative total obtained by adding together for the 10 years the individual yearly totals of farms keeping records—approximately 146 farms per year for 10 years.

**Table 2. Size of Herd, Production, and Feeds per Cow, 1928-1937**

| Items | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 10-yr. average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farms | 124 | 172 | 180 | 147 | 143 | 108 | 120 | 150 | 152 | 166 | 146 |
| Cows per herd | 13.8 | 14.7 | 15.5 | 17.7 | 18.2 | 18.7 | 19.1 | 17.6 | 18.0 | 17.6 | 17.1 |
| Cows per 100 acres | 8.5 | 8.4 | 8.5 | 8.9 | 9.1 | 9.3 | 9.2 | 8.7 | 8.7 | 8.3 | 8.8 |
| Butterfat per cow, lbs. | 241 | 247 | 242 | 241 | 240 | 243 | 236 | 227 | 243 | 232 | 239 |
| Cows, fall-freshened,* % | 63 | 59 | 58 | 60 | 58 | 59 | 59 | 58 | 53 | 51 | 58 |
| Feeds per cow, lbs.: | | | | | | | | | | | |
| Corn | 232 | 260 | 264 | 375 | 432 | 646 | 618 | 364 | 379 | 268 | 384 |
| Small grain | 1,144 | 1,496 | 1,544 | 1,443 | 1,119 | 1,124 | 639 | 478 | 993 | 867 | 1,085 |
| Com. feeds—under 25% protein | 244 | 138 | 98 | 250 | 320 | 173 | 173 | 194 | 135 | 140 | 186 |
| Com. feeds—over 25% protein | 95 | 95 | 84 | 105 | 83 | 46 | 52 | 63 | 88 | 88 | 80 |
| Alfalfa | 1,697 | 1,650 | 1,733 | 1,692 | 1,837 | 2,114 | 1,879 | 1,742 | 2,717 | 2,496 | 1,956 |
| Other tame hay | 1,182 | 1,043 | 1,090 | 868 | 824 | 744 | 780 | 842 | 748 | 852 | 897 |
| Wild hay | 196 | 267 | 221 | 162 | 173 | 129 | 111 | 103 | 109 | 120 | 159 |
| Corn fodder | 603 | 961 | 800 | 693 | 651 | 643 | 922 | 820 | 423 | 501 | 702 |
| Silage | 7,214 | 7,155 | 7,273 | 7,163 | 6,711 | 6,779 | 7,318 | 7,354 | 7,076 | 6,988 | 7,103 |
| Total concentrates | 1,715 | 1,989 | 1,990 | 2,173 | 1,954 | 1,989 | 1,482 | 1,099 | 1,595 | 1,363 | 1,735 |
| Total dry roughages | 3,678 | 3,921 | 3,844 | 3,415 | 3,485 | 3,630 | 3,692 | 3,507 | 3,997 | 3,969 | 3,714 |
| Total digestible nutrients† | 4,230 | 4,555 | 4,559 | 4,404 | 4,258 | 4,412 | 4,137 | 3,772 | 4,441 | 4,147 | 4,292 |
| T.D.N. per lb. B.F. | 18.2 | 18.8 | 19.2 | 18.7 | 18.0 | 18.5 | 17.9 | 16.9 | 18.5 | 18.6 | 18.3 |
| Protein in T.D.N., % | 12.5 | 12.2 | 12.8 | 12.6 | 12.7 | 12.7 | 12.3 | 12.7 | 13.9 | 13.6 | 12.8 |

* Freshening September to December, inclusive.
† Not including nutrients secured from pasture.

The quantity of concentrates and the total digestible nutrients consumed per cow decreased sharply during the years of short feed supplies following the severe drouths in 1934 and 1936. The butterfat production per cow was also low in 1935 and 1937. There was no significant change in the total quantity of roughages consumed during the period, although there was a substantial change in the kind. In recent years more alfalfa and less other hay and less corn fodder were used. This increased the protein proportion of the total digestible nutrients. In addition to the feeds listed, the cows had pasture during the regular pasture season.

Although the physical factors show a relatively small amount of variation from year to year, the value of feeds and the returns over feed per cow show a wide variation (table 3). The period covered by this study was characterized by wide variations in the general price level. It included the two fairly prosperous years of 1928 and 1929 and the years of severe financial depression immediately following. The value of the feed consumed per cow decreased from $70.45 in 1928 to $34.47 in 1933, a decrease of 51 per cent. The average value of the dairy products produced per cow decreased from $142.67 in 1928 to $59.29 in 1933, a decrease of 58 per cent. The return over feed per cow dropped approximately 65 per cent during the same period. The large decrease in return over feed resulted from the fact that gross returns declined relatively more than feed costs. Butterfat prices paid by creameries declined 59 per cent from 1928 to 1932.

There were much wider variations in return over feed per cow among farmers in the same community in any one year than there were in the returns received by farmers from year to year (table 4). The variation in return over feed per cow is shown graphically in figure 1. Of the three years selected for this illustration, one was a year of high returns, another of average returns, and the third a year of exceptionally low returns. The gen-

**Table 3. Feed Costs and Returns in Dairy Production, 1928-1937**

| Items | 1928 | 1929 | 1930 | 1931 | 1932 | 1933 | 1934 | 1935 | 1936 | 1937 | 10-yr. average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Butterfat per cow, lbs. | 241 | 247 | 242 | 241 | 240 | 243 | 236 | 227 | 243 | 232 | 239 |
| Price per lb. B.F. sold as cream, ¢ | 53.3 | 50.2 | 39.8 | 29.3 | 21.7 | 22.0 | 27.6 | 33.1 | 37.2 | 38.5 | 35.3 |
| Value of skim milk per lb. B.F., ¢ | 5.9 | 5.9 | 4.6 | 3.6 | 2.4 | 2.4 | 3.6 | 3.6 | 4.0 | 3.6 | 4.0 |
| Value of dairy prod. per lb. B.F., ¢ | 59.2 | 56.1 | 44.4 | 32.9 | 24.1 | 24.4 | 31.2 | 36.7 | 41.2 | 42.1 | 39.3 |
| Average value of dairy prod. per cow | $142.67 | $138.57 | $107.45 | $79.29 | $62.64 | $59.29 | $73.63 | $83.31 | $100.12 | $97.67 | $93.93 |
| Feed cost per cow | | | | | | | | | | | |
| Concentrates | $27.65 | $26.35 | $21.06 | $18.16 | $13.87 | $11.41 | $14.34 | $12.76 | $16.85 | $17.84 | $18.03 |
| Roughages | 36.58 | 35.60 | 33.80 | 30.89 | 23.83 | 19.46 | 27.09 | 32.60 | 21.84 | 28.48 | 29.02 |
| Pasture | 6.22 | 6.21 | 6.52 | 4.93 | 3.76 | 3.60 | 3.78 | 5.07 | 5.01 | 4.97 | 5.00 |
| Total feed costs | $70.45 | $68.16 | $61.38 | $53.98 | $41.46 | $34.47 | $45.21 | $50.43 | $43.70 | $51.29 | $52.05 |
| Return over feed per cow | $72.22 | $70.41 | $46.07 | $25.31 | $21.18 | $24.82 | $28.42 | $32.88 | $56.42 | $46.38 | $41.88 |
| Feed cost per lb. B.F., ¢ | 29.6 | 27.9 | 25.7 | 22.8 | 17.2 | 14.4 | 19.4 | 22.5 | 18.2 | 22.6 | 22.1 |

eral shapes of the curves representing the range in return over feed are very similar for all three years. During each year there were a number of extreme variations from the average. A few farmers were very efficient; others were very inefficient and either received a very meager return or actually incurred a loss on the feed consumed by cows.

This study deals principally with variations between farms, for they are largely due to differences in management and in practices followed and are at least partly within the control of the operator. The differences in returns received by an individual farmer from year to year are due primarily to changes in the general price level. The balance of the discussion will be devoted to an analysis of the 1,462 yearly farm records covering the 10-year period 1928-1937, in an effort to determine the major factors and practices causing this variation among farms.

**Table 4. Return over Feed per Cow, 1928-1937**

| Year | Highest | Average | Lowest | Range |
|---|---|---|---|---|
| 1928 | $133 | $72 | $ 2 | $131 |
| 1929 | 127 | 70 | 14 | 113 |
| 1930 | 96 | 46 | 6 | 90 |
| 1931 | 55 | 25 | −6 | 61 |
| 1932 | 47 | 21 | −9 | 56 |
| 1933 | 47 | 25 | 3 | 44 |
| 1934 | 60 | 28 | −2 | 62 |
| 1935 | 71 | 33 | −9 | 80 |
| 1936 | 92 | 56 | 15 | 77 |
| 1937 | 90 | 46 | −5 | 95 |
| 10-year average | 82 | 42 | 1 | 81 |

## Production per Cow

There were wide differences among the herds in the average butterfat production per cow. Approximately 10 per cent of the herds had an average butterfat production of 174 pounds or less per cow, and 5 per cent had an average production of 325 pounds or more.

The high-producing herds yielded the largest return over feed cost (table 5). The average return over feed for the 139 herds in the group with the lowest butterfat production was only $20.00 per cow. The average return over feed for the 69 herds with the highest production was $65.10 per cow or $45.10 more than the low group. For a herd of average size—17 cows—this amounts to $767 more for the high-producing herd. The variation in labor expendi-

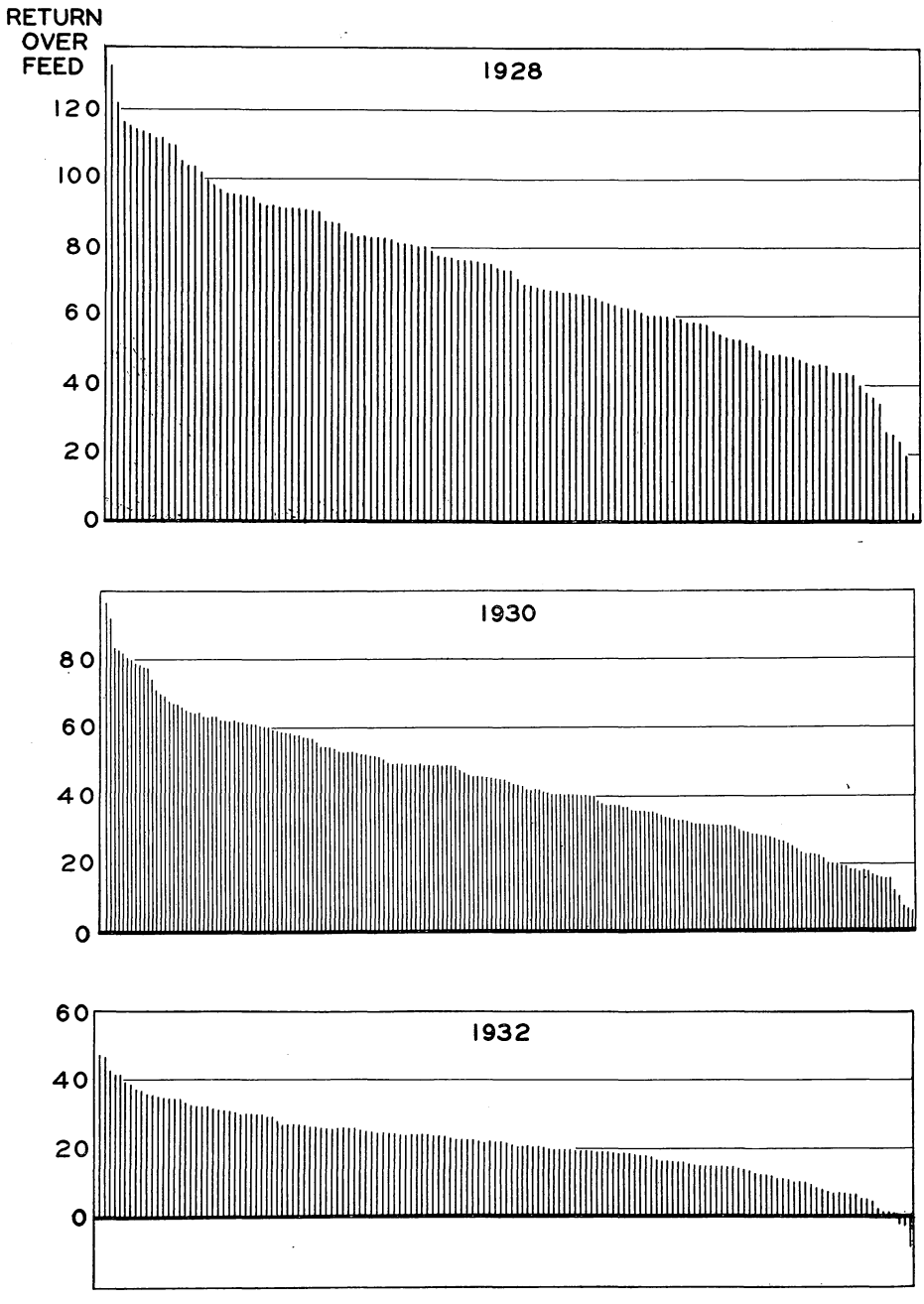


FIG. 1. Variations in return over feed cost per cow, 1928, 1930, and 1932

**Table 5. Relation of Butterfat per Cow to Various Dairy Production Factors, 1928-37**

| Butterfat per cow* Range | Aver-age | Num-ber farms | Re-turn over feed | T.D.N. per cow | Per cent pro-tein in T.D.N. | T.D.N. per lb. B.F. | Index of feed cost per lb. B.F. | Proportion T.D.N. Con-cen-trates | Dry rough-age | Silage | Mo. on pas-ture | Per cent fall fresh-ening | Re-turn from other cat-tle† |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 174 and less | 155 | 139 | $20.00 | 3448 | 12.2 | 22.4 | 119.6 | 20.8 | 47.4 | 31.8 | 5.3 | 48.7 | $2.88 |
| 175-224 | 202 | 439 | 33.54 | 3896 | 12.4 | 19.3 | 102.9 | 25.3 | 47.3 | 27.4 | 5.2 | 50.7 | 3.79 |
| 225-274 | 249 | 533 | 44.32 | 4393 | 13.0 | 17.7 | 97.1 | 30.7 | 41.2 | 28.1 | 5.0 | 60.5 | 5.20 |
| 275-324 | 293 | 282 | 54.79 | 4881 | 13.3 | 16.7 | 93.2 | 34.6 | 38.1 | 27.3 | 4.9 | 66.1 | 6.67 |
| 325 and more | 350 | 69 | 65.10 | 5711 | 14.0 | 16.3 | 93.8 | 37.2 | 37.0 | 24.8 | 4.6 | 60.6 | 11.07 |

* Number of cows in herd was, respectively, 17.0, 17.2, 17.0, 17.0, 15.4.
† Return over feed per head of other dairy cattle.

ture and in buildings and equipment probably would not vary greatly between the two extreme groups.

High production per cow required a heavy rate of feeding.[4] Since the only record available of the quantity of feed obtained from pastures was the number of months the cows were allowed to graze, T.D.N. as used in this study represents feeds consumed other than pasture. The kind and quality of feed are also of considerable importance. The dairy cow is limited in the bulk of feed she can consume. Hence, at the higher levels of feeding it is necessary to provide a large proportion of the digestible nutrients in the form of concentrates and less as roughages. The high-producing herds were also pastured fewer days per year. This is due in part at least to the necessity of barn feeding in the fall when pastures are short if a high production is to be maintained. The percentage of protein in the digestible nutrients was the only measure of quality of feed available in this study. It, however, shows a considerable relationship to production.

For most farm herds, high production is the most profitable production. The amount of digestible nutrients per pound of butterfat declines rapidly as production increases until the higher levels are reached. Likewise the feed cost per pound of butterfat declines with an increase in production. Another advantage of high production per cow is indicated in table 5. Not only is the return over feed per cow increased, but the return over feed for other dairy cattle on the farm increases with the production of the milking herd because the offspring of the high-producing cows command a higher price.

## Feeding Practices Affecting Production and Returns

Feeding methods followed by farmers have a marked influence on returns from the dairy herd. Two majors factors affecting feeding efficiency that were found to have considerable bearing on butterfat production and return over feed were the proportion of total digestible nutrients in the form of protein and the ratio of concentrates to roughages in the ration.

**Proportion of Protein in the T.D.N.**—The proportion of protein in the feed nutrients consumed by dairy cows on the different farms ranged from 7.5 per cent to 18.8 per cent, averaging 12.8 for the 1,462 farms. The distribution of farms according to the proportion of protein in the T.D.N. is shown in figure 2. A range from 11.5 to 14.9 per cent included 65 per cent of the farms.

In table 6 is shown the relationship between the per cent protein in the

[4] The amount of feed given to dairy cows is expressed in terms of total digestible nutrients (T.D.N.). They include all the digestible portion of the proteins, fiber, nitrogen-free extract, and fat. From Morrison, F. B., Feeds and Feeding. The Morrison Publishing Company, 1936, page 42.

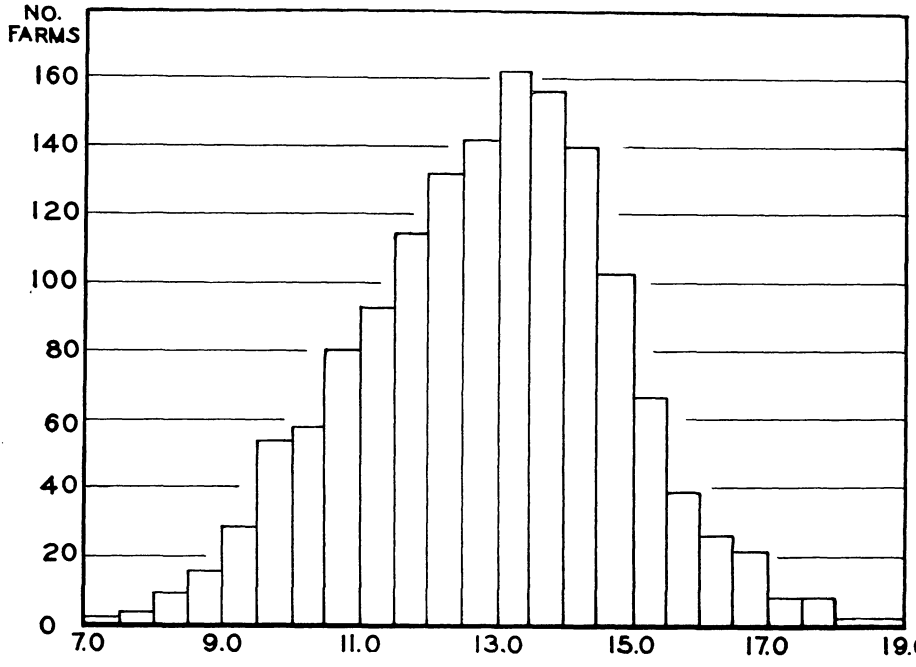


FIG. 2. Distribution of farms according to the proportion of protein in the total digestible nutrients

digestible nutrients consumed per cow and several other measures of efficiency in dairy production when the data are sorted into three nearly homogeneous groups as far as rate of feeding is concerned. In all three levels of feeding the butterfat production per cow was highest for the herds fed the high-protein ration. However, the proportion of protein is most important at the higher levels of feeding. This is readily apparent from the data in table 6 when allowances are made for the small variations in rate of feeding within each of the three groups. The range in production per cow between the high- and low-protein rations for the herds receiving less than 4,000 pounds of digestible nutrients was 20 pounds of butterfat and for the same group the range in digestible nutrients consumed was 175. If it is assumed that 16 pounds of digestible nutrients were needed to produce one pound of butterfat in this group, the increase in nutrients consumed would account for more than one half of the 20 pounds of increased butterfat production per cow. For the herds fed 4,000 to 4,999 pounds of digestible nutrients there was no significant change in the quantity of feed consumed, and for the herds receiving over 5,000 pounds of digestible nutrients a very small proportion of the increase in production could be attributed to an increase in feed consumed. When cows are underfed, quantity rather than quality of feed has the greatest effect on production.

The same trend is observed in the amount of digestible nutrients required to produce a pound of butterfat. Each increase in the proportion of protein in the T.D.N. brought about a decrease in the digestible nutrients required re-

**Table 6. Relation of Proportion of Protein in the Digestible Nutrients and Total Digestible Nutrients per Cow to Various Dairy Production Factors, 1928-37**

| Per cent protein in digestible nutrients | Number of farms | Return over feed | B.F. per cow | Lbs. T.D.N. per cow | T.D.N. per lb. B.F. | Index of feed cost per lb. B.F. |
|---|---|---|---|---|---|---|
| | | | T.D.N. per cow, 3,999 and less | | | |
| 11.4 and less | 193 | $40.81 | 202 | 3,333 | 16.5 | 86.3 |
| 11.5 to 13.4 | 211 | 42.29 | 218 | 3,510 | 16.1 | 90.0 |
| 13.5 and more | 202 | 43.07 | 222 | 3,508 | 15.8 | 89.8 |
| | | | T.D.N. per cow, 4,000-4,999 | | | |
| 11.4 and less | 90 | 38.47 | 229 | 4,603 | 20.1 | 101.8 |
| 11.5 to 13.4 | 205 | 40.67 | 245 | 4,655 | 19.0 | 102.6 |
| 13.5 and more | 210 | 41.49 | 253 | 4,630 | 18.3 | 103.8 |
| | | | T.D.N. per cow, 5,000 and over | | | |
| 11.4 and less | 59 | 34.50 | 250 | 5,800 | 23.2 | 115.5 |
| 11.5 to 13.4 | 134 | 35.90 | 264 | 5,755 | 21.8 | 116.1 |
| 13.5 and more | 158 | 40.46 | 289 | 5,924 | 20.5 | 114.6 |

gardless of the level of feeding. Furthermore the decrease in nutrients needed, resulting from additional protein, was more marked in the higher levels of feeding. In the rations of 3,999 pounds of digestible nutrients and less per cow, an increase in the percentage of protein from 11.4 or less to somewhere within the range of 11.5 to 13.4 per cent brought about a decrease of 0.4 pound of T.D.N. consumed per pound of butterfat. A further increase in protein to 13.5 per cent or more brought about a decrease of 0.3 pound of T.D.N. per pound of butterfat. In the next level of feeding—4,000 to 4,999 pounds of T.D.N.—similar increases in protein brought about decreases of 1.1 pounds and 0.7 pound of T.D.N. consumed per pound of butterfat respectively, and in the highest level—5,000 and more pounds of T.D.N. per cow—the decreases were 1.4 pounds and 1.3 pounds T.D.N. consumed per pound of butterfat.

Although high-protein feeds are more costly than most other feeds, the feed cost per pound of butterfat produced did not show a significant relationship with the percentage of protein in the ration. Consequently, increased production at the same feed cost per unit of production resulted in a higher return over feed with each increase in the protein content of the ration. The increase in return over feed was most marked in the higher levels of feeding. Variability in the protein content of the ration was one of the important reasons for the differences existing from farm to farm in the returns secured from dairy cows.

**Ratio of Concentrates to Roughages**—The feeds for cattle fall into three major classifications—concentrates, roughages, and pasture. There is a great deal of variation from farm to farm in the proportions of each used in the ration. As shown in figure 3, practically all of the herds received some concentrates, and for two thirds of them the concentrates contributed over 25 per cent of the total digestible nutrients in the ration other than pasture. Only 19 of the 1,462 herds received no concentrates.

The feeding of concentrates was an important factor in securing high production per cow (table 7). In every group, regardless of the level of feeding, an increase in concentrates and a decrease in roughages brought about a very marked increase in the amount of butterfat and in the return over feed per cow. Likewise, physical efficiency in production increased with every increase in the proportion of the digesti-

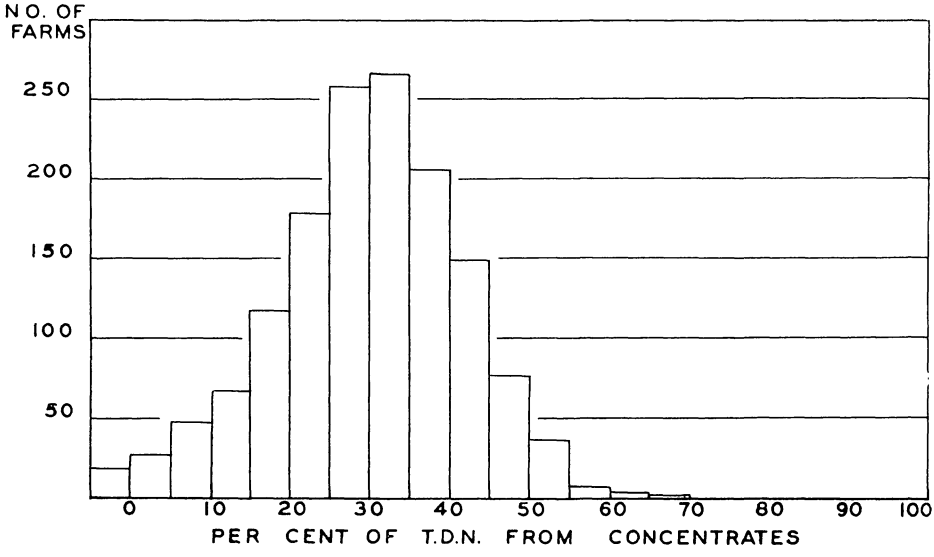


FIG. 3. Distribution of farms according to proportion of total digestible nutrients (other than that received from pasture) from concentrates

ble nutrients in the form of concentrates. The greatest increase in the efficiency with which feed was utilized occurred in the higher levels of feeding and within these higher levels the efficiency of feed utilization decreased when larger proportions of concentrates were fed.

Although a pound of T.D.N. in concentrates usually costs more than a pound in roughage, the advantage from the standpoint of more efficient feed utilization was more than enough to offset this extra cost. The combination of fairly constant feed costs per unit of product and higher production led to a significant increase in return over feed with each addition to the proportion of nutrients secured from concentrates.

**Table 7. Relation of Proportion of the Total Digestible Nutrients from Concentrates and of Total Digestible Nutrients per Cow to Various Dairy Production Factors, 1928-37**

| Percentage T.D.N. from concentrates | Number of farms | Return over feed | B.F. per cow | T.D.N. per cow | T.D.N. per lb. B.F. | Index of feed cost per lb. B.F. |
|---|---|---|---|---|---|---|
| T.D.N. per cow, 3,999 and less | | | | | | |
| 29 and less | 383 | $40.39 | 205 | 3,342 | 16.3 | 88.9 |
| 30 to 39 | 153 | 44.91 | 228 | 3,625 | 15.9 | 88.9 |
| 40 and over | 70 | 47.76 | 240 | 3,720 | 15.5 | 87.7 |
| T.D.N. per cow, 4,000-4,999 | | | | | | |
| 29 and less | 208 | 38.31 | 235 | 4,630 | 19.7 | 104.0 |
| 30 to 39 | 190 | 41.58 | 252 | 4,686 | 18.6 | 103.1 |
| 40 and over | 107 | 43.36 | 255 | 4,580 | 18.0 | 100.9 |
| T.D.N. per cow, 5,000 and over | | | | | | |
| 29 and less | 126 | 34.29 | 254 | 5,765 | 22.7 | 116.8 |
| 30 to 39 | 129 | 39.19 | 278 | 5,810 | 20.9 | 114.0 |
| 40 and over | 96 | 40.16 | 291 | 5,995 | 20.6 | 115.2 |

One may conclude from these data that variations in the amount of concentrates consumed per cow were one of the important reasons for the variations among these farms in the production. The relative profitableness of feeding a large proportion of the total digestible nutrients in the form of concentrates will depend on the relative cost of the various types of feeds. The 10-year period covered by this study represents a wide variety of price relationships between dairy products and feeds. In 1928 and 1929 the dairy product-feed price ratios were very favorable. By 1932 and 1933 the price of dairy products was very low in comparison to feed prices. During these years of unfavorable dairy product-feed price ratios the feeding of a considerable proportion of digestible nutrients (other than those secured from pasture) in the form of concentrates brought about enough of an increase in gross returns to offset any increase in feed cost due to the adding of concentrates to the ration. For the 10-year period as a whole the feeding of a considerable proportion of digestible nutrients in the form of concentrates proved to be profitable for the average farmer. A more complete discussion of this appears in a later section.

**Months Cows Were on Pasture**—No method has been devised whereby either the quantity or quality of feed an animal secures from pasture under ordinary farm conditions can be measured. Hence it is impossible to show a definite relationship of feed from pasture to the various dairy production factors. The only information concerning pastures available for use in this study was the number of months the cows had access to pasture.

The data in table 8 show that as the number of months the cows were on pasture increased, the butterfat production per cow declined. At the same time the T.D.N. per cow from feeds other than pasture and the feed cost per pound of butterfat also declined. Since pasture supplies a comparatively cheap form of nutrients for cows, the lower production per cow for those farms with the longer pasture season was offset by a lower feed cost per pound of butterfat produced. This resulted in no significant change in the return over feed cost per cow.

There is an inverse relationship between months on pasture and fall freshening. It is probable that the farmers who planned to have the cows freshen in the spring did so with the intention of taking full advantage of the low cost nutrients secured from pastures.

## Time of Freshening

The time of freshening is a factor accounting for some of the variation in the production per cow and in the return over feed received by farmers. Fifty-six per cent of the dairy cows included in this study freshened during the fall months of September to

**Table 8. Relation of the Number of Months Cows Were on Pasture to Various Dairy Production Factors, 1928-37**

| Months on pasture | | Number farms | Return over feed | B.F. per cow | T.D.N. per cow | T.D.N. per lb. B.F. | Index of feed cost per lb. B.F. | Per cent protein in T.D.N. | Proportion T.D.N. | | | Per cent fall freshening |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range | Average | | | | | | | | Concentrates | Dry roughage | Silage | |
| 4.1 and less | 3.5 | 206 | $41.02 | 258 | 4,985 | 19.7 | 106.0 | 13.0 | 31.3 | 39.6 | 29.1 | 61.8 |
| 4.2-4.7 | 4.5 | 293 | 41.97 | 244 | 4,417 | 18.6 | 99.9 | 12.8 | 29.7 | 41.4 | 28.9 | 59.8 |
| 4.8-5.3 | 5.1 | 431 | 40.15 | 239 | 4,337 | 18.5 | 101.9 | 12.9 | 29.0 | 42.2 | 28.8 | 58.0 |
| 5.4-5.9 | 5.6 | 370 | 42.12 | 234 | 4,038 | 17.6 | 96.5 | 12.8 | 28.3 | 44.1 | 27.6 | 55.6 |
| 6.0 and more | 6.4 | 162 | 40.00 | 221 | 3,809 | 17.6 | 95.8 | 12.7 | 28.4 | 48.2 | 23.4 | 50.9 |

**Table 9. Relation of Proportion of Fall Freshening to Various Dairy Production Factors, 1928-37**

| Per cent fall freshening | | Number farms | Return over feed per cow | B.F. per cow | T.D.N. per cow | T.D.N. per lb. B.F. | Index of feed cost per lb. B.F. | Per cent protein in T.D.N. | Proportion T.D.N. | | | Mo. on pasture | Return from other cattle* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Range | Average | | | | | | | | Concentrates | Dry roughage | Silage | | |
| 29.9 and less | 16.8 | 206 | $37.32 | 217 | 3,964 | 18.7 | 100.0 | 12.3 | 25.2 | 45.3 | 29.5 | 5.1 | $3.93 |
| 30.0-49.9 | 39.6 | 308 | 40.14 | 232 | 4,213 | 18.4 | 100.2 | 12.6 | 29.2 | 43.4 | 27.4 | 5.1 | 3.80 |
| 50.0-69.9 | 58.9 | 433 | 42.28 | 243 | 4,289 | 18.0 | 99.0 | 12.9 | 30.8 | 41.7 | 27.5 | 5.0 | 5.39 |
| 70.0-89.9 | 78.8 | 376 | 42.07 | 246 | 4,452 | 18.4 | 100.4 | 12.9 | 29.3 | 41.8 | 28.9 | 5.0 | 5.47 |
| 90.0 and more | 95.5 | 139 | 43.08 | 258 | 4,719 | 18.8 | 102.3 | 13.5 | 29.9 | 44.0 | 26.1 | 4.9 | 8.04 |

* Return over feed per head of other dairy cattle.

December inclusive. Less than 25 per cent of fall freshening was reported on 10 per cent of the farms, from 25 to 49 per cent on 25 per cent, from 50 to 74 per cent on 36 per cent, and 75 per cent or over on the remaining 29 per cent.

A very marked association occurred between the percentage of fall freshening and butterfat production per cow (table 9). A portion of this increase in production was no doubt due to the heavier rate of feeding accompanying the higher proportion of fall freshening. However, a more detailed inspection of the data by groupings of herds similar as far as rate of feeding is concerned reveals a significant advantage in favor of the larger proportion of fall freshening in the higher levels of feeding. In the lower levels of feeding (less than 4,000 pounds of total digestible nutrients) the time of freshening did not affect production or return over feed. The number of months of pasture per cow did not change materially with a variation in the proportion of fall freshening.

The feed cost per pound of butterfat remained practically constant. As a result of the larger physical output and constant feed cost per unit of output the return over feed per cow was larger in the case of the herds with the greater amount of fall freshening. Part of the increase in production was due to the fact that fall-freshened cows receive a boost in production in the spring when they are turned out on pasture and thereby prolong the lactation period.[5] Also under this system the cows will be nearing the close of the lactation period during the summer when the weather is hot and the pastures generally short.

There are several other arguments in favor of fall freshening that should be noted. The practice enables the farmer to distribute the farm work load more uniformly throughout the year. When cows freshen in the fall, more of the work of milking comes in the winter when farm work is slack. The practice also enables the farmer to obtain a greater proportion of his dairy products at a time when prices are generally somewhat higher.

The comparative expense and returns from the raising of fall and spring calves must be considered. Fall freshening is an important factor leading toward a higher return over feed from the cattle other than cows. The herds with 90 per cent or more of fall freshening received approximately twice as much return over feed from cattle other than dairy cows as compared with the herds freshening during the rest of the year.

## Price Received for Butterfat

In the preceding discussion a uniform price for butterfat has been applied on all farms to simplify the analysis. However, the price received

[5] Petersen, W. E., Dairy Science, J. B. Lippincott Co. (1939), page 327.

per pound of butterfat may be a significant factor affecting the return per cow and to some extent the feeding practices followed. Ninety per cent of the farmers included in this study marketed their dairy products as cream for butter manufacture by local creameries. All patrons of these creameries received the same price for their butterfat except as the grade or seasonal distribution of marketing varied. There was relatively little variation in the prices paid among the different creameries in the area at any time. The other 10 per cent of these farmers marketed their dairy output largely as fluid milk either for cheese manufacture or for retail distribution. Some of the latter was sold wholesale and some was retailed by the farmers themselves. Not only did the price for butterfat in whole milk differ materially from that sold as cream but it also varied widely among different farms according to the kind and quality of market available. Butterfat in milk for cheese manufacture commanded a relatively low price—sometimes but little higher than that received for butterfat for butter manufacture, but the price of milk for retail distribution was generally much higher and varied widely between different markets.

In table 10 the data are classified on the basis of the price actually received per pound of butterfat sold, with approximately one fourth of the cases in the low group and a similar number in the high group. There was a relatively narrow range between the low and the medium groups. Most of the farmers in these two groups sold to creameries and the range of 2 cents per pound between them represents the difference in price among the creameries and in the quality of the product delivered. The average butterfat production for the low-price group was 231 pounds per cow. An increase of 2 cents per pound in the price of butterfat would have increased the average return over feed for this group of farmers by $4.62 per cow or 18 per cent. To the extent that this disparity in price was due to a difference in the quality of the product this represented a reduction in income that was to a considerable degree within the control of the farmer.

The group receiving the higher price included a considerable number of farms where the butterfat was retailed as milk or cream or where the whole milk was sold to a cheese factory. Not all farmers, however, had such markets available to them.

The greater production of butterfat per cow in those herds whose products commanded the highest prices doubtless represents the result of the farmers' efforts to take advantage of these higher prices. There was an incentive for increasing the quantity of feed per cow as long as the efficiency of feeding was not lowered. The pounds of digestible nutrients per pound of butterfat, the feed cost per pound of butterfat, and the other factors included in this study did not show a significant difference among the three price groups.

While this study was primarily concerned with a determination of the management practices and factors

**Table 10. Relation of Price Received per Pound of Butterfat Sold to Various Dairy Production Factors, 1928-37**

| Group | Index of price received per lb. B.F. Average | Number farms | Return over feed | B.F. per cow | Lbs. T.D.N. per cow | Lbs. T.D.N. per lb. B.F. | Index of feed cost per lb. B.F. | Cows in herd |
|---|---|---|---|---|---|---|---|---|
| Low | 90.4 | 372 | $30.96 | 231 | 4,121 | 18.3 | 99.8 | 15.6 |
| Medium | 95.8 | 759 | 36.80 | 239 | 4,334 | 18.6 | 100.3 | 16.5 |
| High | 120.5 | 331 | 63.50 | 250 | 4,467 | 18.0 | 99.7 | 19.8 |

**Table 11. Relation of the Price of Butterfat to the Feed Cost per Pound of Butterfat, 1928-1937**

| Year | Percentage of 1928-37 average represented by | |
|---|---|---|
| | Value of dairy products | Cost per pound of butterfat |
| 1928 | 151 | 134 |
| 1929 | 143 | 126 |
| 1930 | 113 | 116 |
| 1931 | 84 | 103 |
| 1932 | 61 | 78 |
| 1933 | 62 | 65 |
| 1934 | 79 | 88 |
| 1935 | 93 | 102 |
| 1936 | 105 | 82 |
| 1937 | 107 | 102 |

which account for the variations among farmers in the returns received from livestock, this discussion would not be complete without some mention of the effects of changes in prices from year to year, since these affect management practices. The data in table 11 show not only the relatively wide fluctuation in the value of dairy products and the feed cost over the 10-year period, but it also shows that they did not always change uniformly from year to year. In 1928 the value of dairy products and the price of feeds were high in comparison with the 10-year average. In this same year the dairy product-feed price ratio was very favorable. However, in the succeeding years the value of dairy products declined faster and farther than feed costs. By 1932 the value of dairy products was 61 per cent of the 10-year average. The low point in feed prices occurred a year later when they were 65 per cent of the average for the decade. In 1935 and again in 1937 feed prices were relatively high because of short feed crops during the drouth years of 1934 and 1936.

Changes in the dairy product-feed price ratios affect materially the relative profitableness of many feeding and management practices. In table 12 the data are classified according to the amount of butterfat produced per cow. The return over feed is presented for a year of high prices and favorable dairy product-feed price ratios; for a year of low prices and unfavorable price ratios; and for the average prices for the 10 years studied. The price of feed and the price of dairy products represent the average prices for the years selected (see tables 1 and 3 respectively). Regardless of the level of prices or the favorableness of the dairy product-feed price ratios, high butterfat production per cow proved to be more profitable than a low production. There was a very wide range between years in the return over feed. In 1932 the group with the highest average butterfat production per cow received a lower return over feed than the group with the lowest production in 1928.

The relationship between the price of dairy products and the feed cost affects the relative profitableness of increasing the protein content of a dairy ration. When 1928 prices are used, the group of farmers who fed approximately 16 per cent of the digestible nutrients in the form of protein received $8.41 per cow more return over feed

**Table 12. Effect of Changes in Prices on the Return over Feed Secured from Dairy Cows on Farms Classified According to Butterfat Produced per Cow**

| Butterfat per cow | | Number farms | Return over feed per cow | | |
|---|---|---|---|---|---|
| Range | Average | | 1928-37 prices | 1928 prices | 1932 prices |
| 174 and less | 155 | 139 | $20.00 | $36.89 | $ 5.43 |
| 175-224 | 202 | 439 | 33.54 | 57.97 | 12.93 |
| 225-274 | 249 | 533 | 44.32 | 75.95 | 18.43 |
| 275-324 | 293 | 282 | 54.79 | 92.59 | 23.73 |
| 325 and more | 350 | 69 | 65.10 | 109.90 | 28.00 |

**Table 13. Effect of Changes in Prices on the Return over Feed Secured from Dairy Cows on Farms Classified According to Proportion of Protein in the T.D.N.**

| Per cent protein in T.D.N. | | Number farms | Return over feed per cow | | |
|---|---|---|---|---|---|
| Range | Average | | 1928-37 prices | 1928 prices | 1932 prices |
| 9.4 and less | 8.8 | 59 | $39.60 | $65.99 | $18.13 |
| 9.5-11.4 | 10.6 | 283 | 39.52 | 67.48 | 16.43 |
| 11.5-13.4 | 12.5 | 550 | 40.63 | 70.03 | 16.01 |
| 13.5-15.4 | 14.3 | 465 | 42.00 | 72.87 | 16.44 |
| 15.5 and more | 16.4 | 105 | 43.40 | 74.40 | 17.61 |

than the group feeding only 9 per cent protein (table 13). With 1932 prices (unfavorable dairy product-feed price ratio) there was no material difference between the two groups in the return received. High-protein feeds are generally higher in price. With low prices received for the product, low cost feeds become increasingly important.

During periods of relatively high butterfat prices, the feeding of a comparatively large proportion of the nutrients in the form of concentrates was a profitable practice (table 14). If the 1928 prices are applied to the data, the return over feed for the high-concentrate ration was $74.43 per head as compared to $64.37 for the low-concentrate ration. On the other hand, when 1932 average prices are applied to the data, the greater cost of the high-concentrate rations offset the increase in butterfat production.

Fall freshening is an important factor affecting returns from dairy production (table 15). A high percentage of fall freshening has a greater effect on return over feed per cow during periods of high prices than during periods of low prices. In fact these data indicate that, in general, good management practices add more to returns during periods of high prices than during periods of low prices. Actually they have a chance to affect returns to a greater extent when prices are favorable.

**Table 14. Effect of Changes in Prices on the Return over Feed Secured from Dairy Cows on Farms Classified According to the Percentage of Digestible Nutrients Obtained from Concentrates**

| Per cent T.D.N. from concentrates | | Number farms | Return over feed per cow | | |
|---|---|---|---|---|---|
| Range | Average | | 1928-37 prices | 1928 prices | 1932 prices |
| 19.9 and less | 11.8 | 281 | $37.93 | $64.37 | $16.20 |
| 20.0-29.9 | 25.1 | 436 | 39.61 | 68.27 | 15.61 |
| 30.0-39.9 | 34.2 | 472 | 42.42 | 73.29 | 16.56 |
| 40.0-49.9 | 43.4 | 225 | 44.09 | 76.30 | 17.16 |
| 50.0 and more | 53.5 | 48 | 42.61 | 74.43 | 16.04 |

**Table 15. Effect of Changes in Prices on the Return over Feed Secured from Dairy Cows on Farms Classified According to the Percentage of Fall Freshening**

| Per cent fall freshening | | Number farms | Return over feed per cow | | |
|---|---|---|---|---|---|
| Range | Average | | 1928-37 prices | 1928 prices | 1932 prices |
| 29.9 and less | 16.8 | 206 | $37.32 | $64.23 | $14.98 |
| 30.0-49.9 | 39.6 | 308 | 40.14 | 68.44 | 16.01 |
| 50.0-69.9 | 58.9 | 433 | 42.28 | 72.66 | 17.25 |
| 70.0-89.9 | 78.8 | 376 | 42.07 | 72.57 | 16.73 |
| 90.0 and more | 95.5 | 139 | 43.08 | 74.57 | 16.77 |

## Cumulative Effect of Excelling in a Number of Management Factors

In the preceding discussion of dairy production, a number of management factors and practices have been studied with the view of determining the major factors causing a variation in return over feed among farms. Because of the interrelationship between the various factors studied, it is difficult to measure accurately the independent relationship of each one to production and to return over feed per cow. The combined effect of these factors on production and returns can, however, be shown. Five factors found to have a considerable relationship to return over feed were used, namely: (1) pounds of butterfat produced per cow, (2) total digestible nutrients per pound of butterfat, (3) the percentage of protein in the T.D.N., (4) the proportion of the digestible nutrients derived from concentrates, and (5) the percentage of fall freshening. A relatively high standing in these factors may be expected to have a favorable influence on the return over feed.

Some farmers excelled in all five factors while others were below the average of the group in all the factors. Others were above average in some of the factors and below in some. The cumulative effect on return over feed from excelling in the five selected factors is shown in figure 4. The average return over feed per cow for the 139 herds which excelled in all five factors was $59. Seventy-one farmers were below average in all five factors. They received only $29 return over feed per cow. The difference between the two extremes amounts to $30 per cow or $510 for a herd of average size, 17 cows.

The foregoing shows that although the individual effect of each factor may not have appeared to be very large, the combined effect of the five selected factors showed a striking correlation with return over feed. There are other factors of importance, but some do not lend themselves to this type of an analysis or were not measured in this study. However, these five factors are sufficient to account for a considerable proportion of the range in return over feed among farmers.

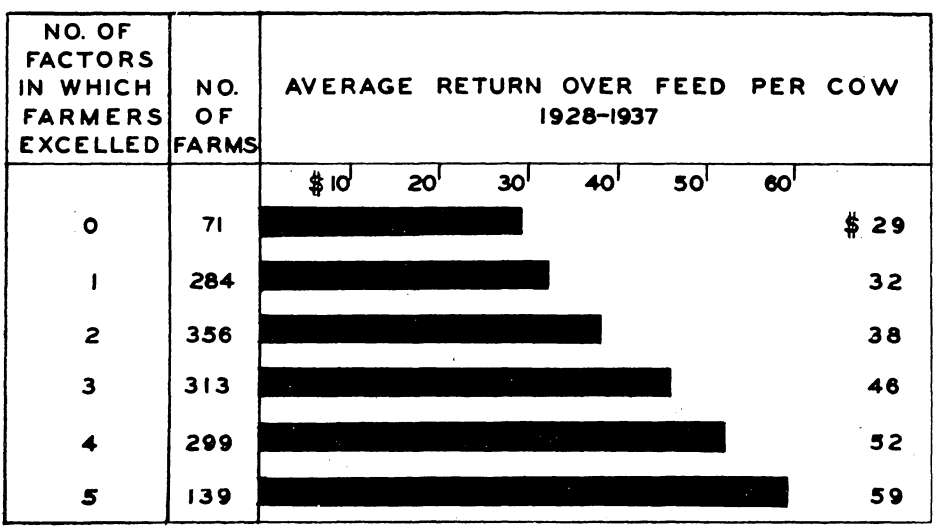


FIG. 4. Average return over feed per cow on farms grouped according to number of selected factors in which farmer was above average, 1928-37

## Factors Causing Variations in Returns from Other Dairy Cattle

THIS study thus far has dealt only with the milk cows on the farms studied. In addition to the milking herd, all farms had other cattle kept partly for replacement and partly for sale. These other dairy cattle included calves, heifers not yet fresh, young bulls, the herd sire, and occasionally some cattle kept for slaughter. On most of these farms the herds were maintained by replacements raised on the farm and in the better herds both heifers and bulls were raised for sale.

The return over feed per head of other dairy cattle varied considerably from year to year with changes in the prices of cattle and of feeds. There were also some wide variations among different farms each year. These variations are shown in table 16. Two of the factors causing these variations have already been mentioned—the level of butterfat production of the dairy herd and the time of the year that the calves are born. Other factors of importance were the net annual increase in value per head (gross returns), the feed cost per head, and the percentage annual death loss. Each of these factors showed a definite relationship to return over feed per head of young dairy cattle. The cumulative effect of the five factors is shown in figure 5. The 262 farmers who were below the average of the group in all five factors or who excelled in only one factor did not receive sufficient income to cover the value of the feeds consumed. The group excelling in all of the factors received an average return of $19.43 to pay for the use of buildings, equipment, labor, and other items of cost. In other words, these five factors accounted for a considerable portion of the differences in the return over feed, as shown by the farm records—differences due to variations among farmers in the management of the herd.

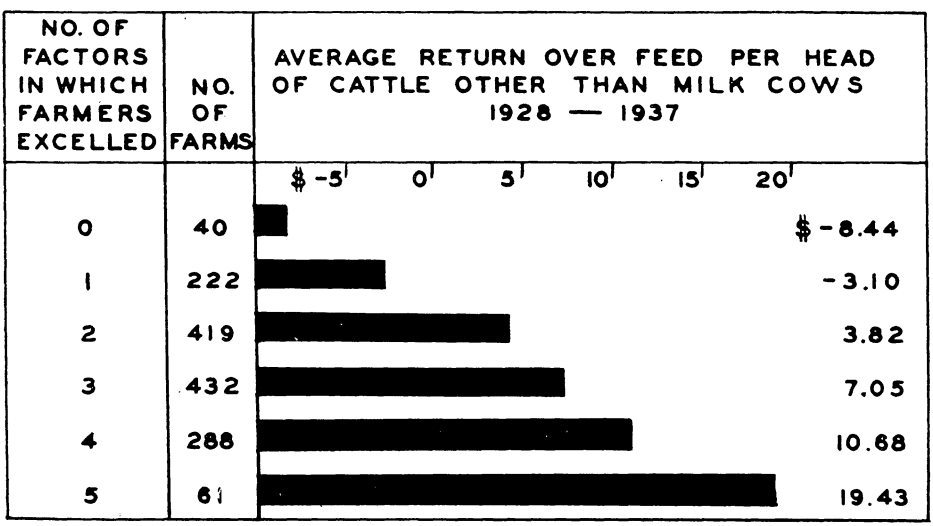


FIG. 5. Average return over feed per head of cattle other than milk cows grouped according to number of selected factors in which farmers excelled, 1928-37

Table 16. Return over Feed Cost per Head of Cattle Other Than Dairy Cows, 1928-1937

| | Highest | Average | Lowest | Range |
|---|---|---|---|---|
| 1928 | $60.44 | $16.58 | $—39.84 | $100.28 |
| 1929 | 97.27 | 20.55 | —17.94 | 115.21 |
| 1930 | 72.49 | 1.76 | —26.47 | 98.96 |
| 1931 | 28.95 | —4.57 | —31.38 | 60.33 |
| 1932 | 26.80 | —4.12 | —22.60 | 49.40 |
| 1933 | 21.93 | — .58 | —12.86 | 34.79 |
| 1934 | 18.42 | —4.12 | —34.39 | 52.81 |
| 1935 | 72.16 | 8.83 | —18.59 | 90.75 |
| 1936 | 42.05 | 6.69 | —32.35 | 74.40 |
| 1937 | 58.29 | 10.03 | —16.51 | 74.80 |
| 10-year average | 49.88 | 5.10 | —25.29 | 75.17 |

# Using Records to Increase Dairy Returns

AN important use of the records upon which this study is based is the improvement of dairy practices and the returns from the dairy enterprise on the farms covered by them. These records differ from cow testing association records in that they cover the whole dairy herd but do not include feed or production reports for individual animals within the herd. On the other hand they contain more detailed information as to the whole dairy enterprise, dairy practices, and more complete and accurate feed records. They have a further advantage in that they cover the entire farm business and thus enable the farmer to study his dairy herd in its relation to the farm organization. They provide a basis for maintaining a balance between the different enterprises making up the farm business.

These records covered an average of 146 farms each year. However, there was so much turnover of farms from year to year that it was impossible to note the improvements resulting from the use of the records by comparing the practices and returns in 1937 with those in 1928. Only 20 identical farmers were included for all of the 10 years and some of these moved from one farm to another or changed the acreage farmed during the period. It is interesting to note that the return over feed per cow for these 20 farmers was 8 per cent higher than that of the entire group in 1928 and 24 per cent higher in 1937. This difference, measured in terms of the price level of 1928, would indicate an advantage of approximately $200 gain for the entire cow herd as the result of the relative improvement during the 10-year period. This may not be a large gain but would pay the fee for the accounting service for a considerable period of years.

The improvement made in the practices on some of the individual herds for which 10-year records are available and its effect on returns can be brought out most effectively by individual examples. The relative ranking of Farm A in each of the five factors discussed in the previous section and the return over feed are shown for the years 1928 and 1937 in thermometer chart form in figure 6. A material improvement of each of the factors relative to the average was effected and the returns over feed increased from 84 per cent to 167 per cent of the average return. The return over feed for the herd of 27 dairy cows was $856 greater in 1937 than in 1928, if the same prices for feeds and dairy products are used for each year.

A similar graph showing the same dairy herd improvement factors on Farm B appears in figure 7. Production and returns over feed were at a relatively low level in 1928, but with an

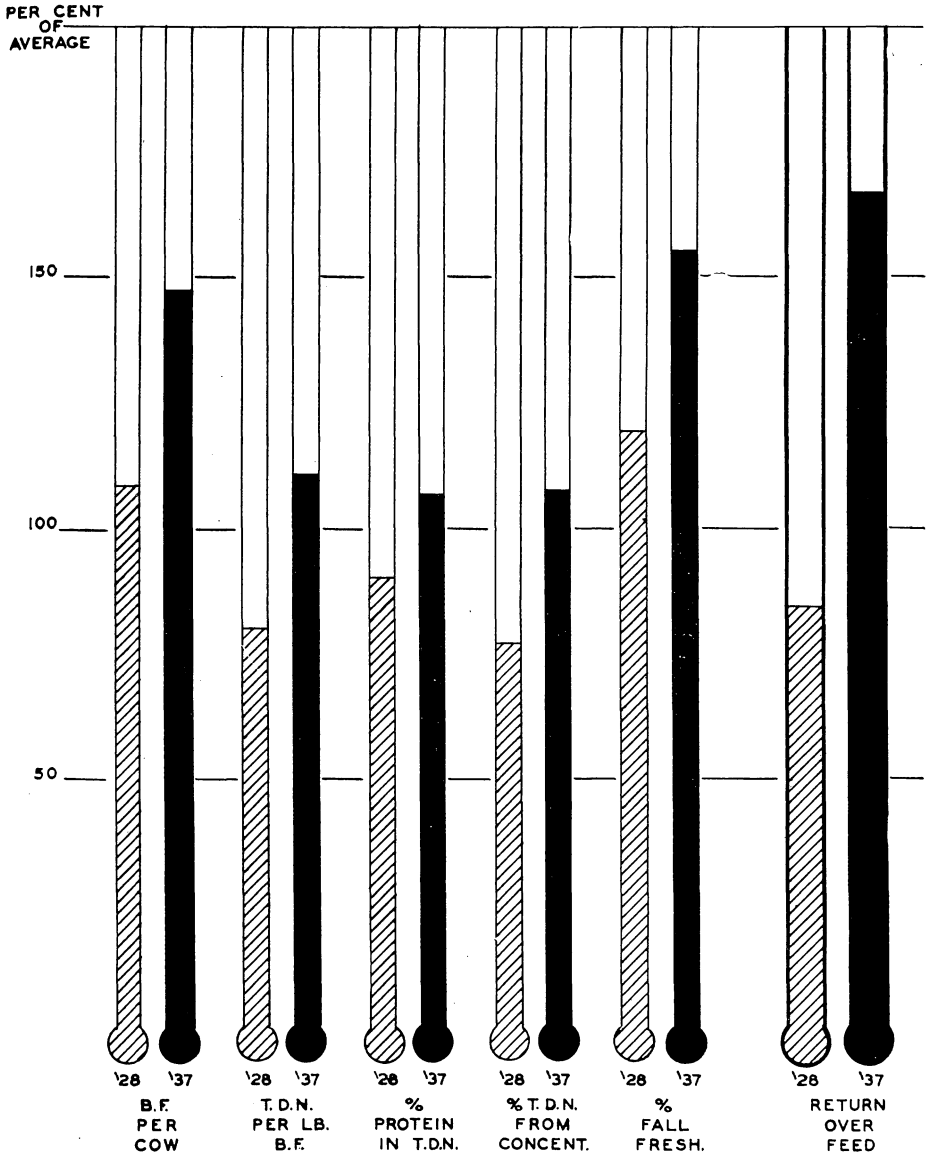


FIG. 6. Improvement in dairy practices and in return over feed per dairy cow on Farm A from 1928 to 1937

NOTE: Returns were computed on the basis of the same prices for feeds and dairy products in 1928 and 1937 to eliminate the effect of changes in the price level. All measurements are in terms of percentages of the average of all farms covered by this study in 1928 and 1937. Returns shown in figures 7 and 8 were computed on the same basis.

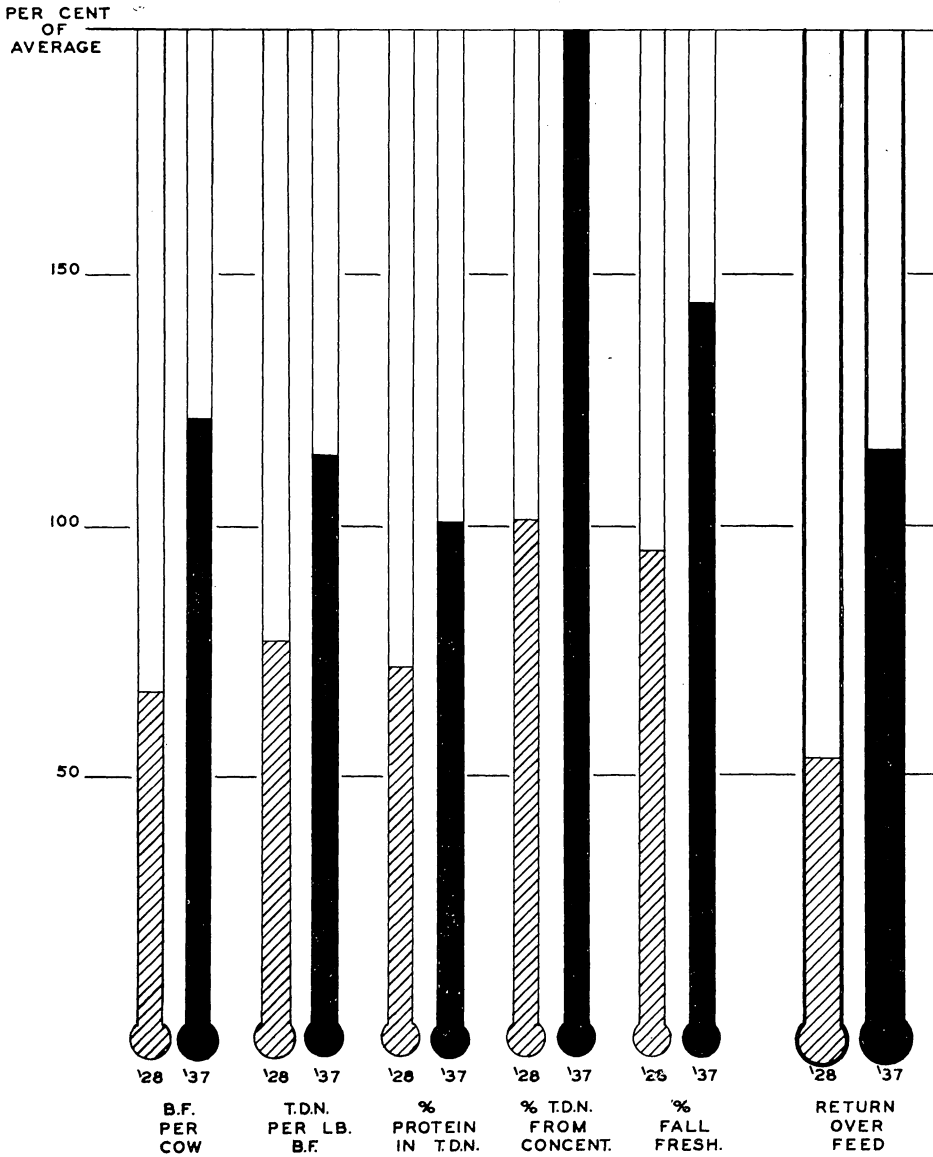


FIG. 7. Improvement in dairy practices and in return over feed per dairy cow on Farm B from 1928 to 1937 (See note on figure 6)

improvement in all of the factors, the returns over feed were more than doubled in the 10-year period. The mere availability of records of the feed costs and practices of the dairy herd do not in themselves insure improvement. Only as the dairyman studies his records, compares his accomplishments with those of other farmers, and makes a definite effort to improve those prac-

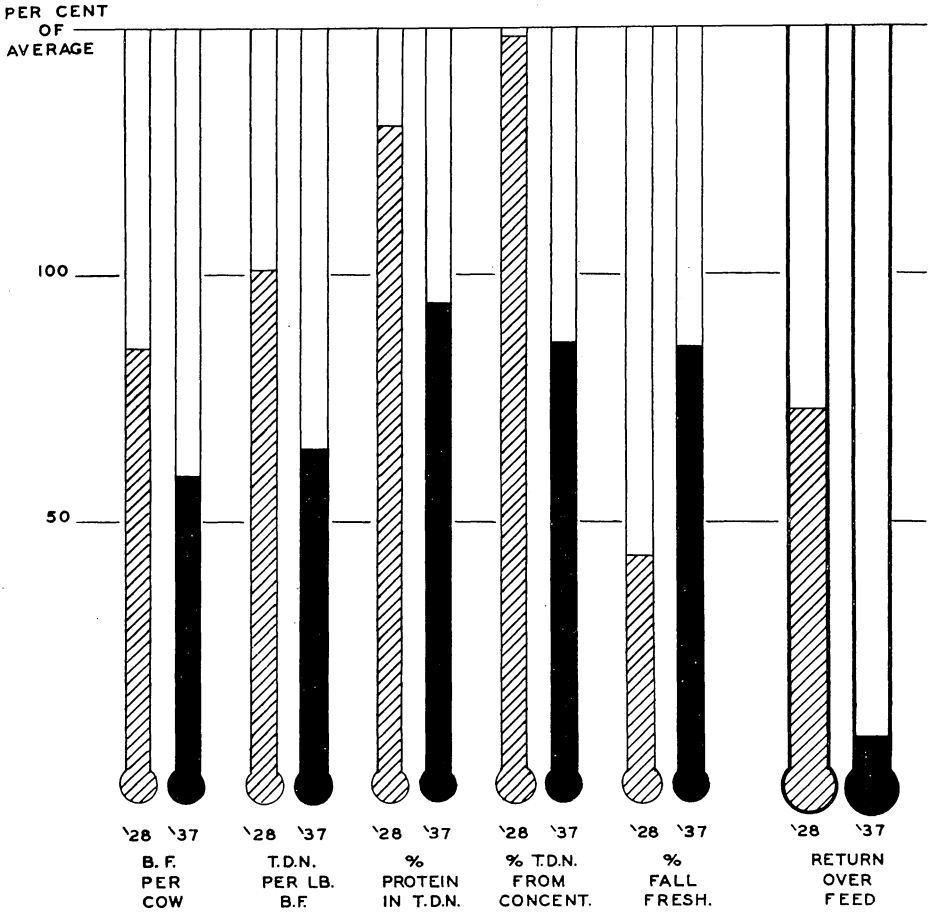


FIG. 8. Regression in dairy practices and in return over feed per dairy cow on Farm C from 1928 to 1937 (See note on figure 6)

tices that limit his earnings, does he profit by his records. This is indicated in figure 8. Farmer C, although supplied with information similar to that used by Farmers A and B, showed a decline in four of the five factors for the 10-year period and a sharp reduction in the return over feed. All of these three illustrations indicate the marked effect of these five factors on the returns from the dairy herd.

The prices of feed and of dairy products varied widely during this period, both in absolute amount and in relationship to each other. To secure maximum returns it was necessary for the dairyman to adjust his feeding practices to the changing price relationships. An illustration of how one farmer did this with the help of his records as a basis for calculating probable returns is shown in table 17. This farmer had a herd of fairly high productive capacity. During the years 1928 to 1930, when the prices of both feed and dairy products were high, he maintained a high rate of feeding and secured both high production and a high return over feed.

**Table 17. Adjusting Dairy Cow Rations on a Southeast Minnesota Farm to Changing Price Conditions**

| | 1928-30 | 1931-33 | 1934-36 |
|---|---|---|---|
| Pounds per cow | | | |
| Concentrates | 2,656 | 2,982 | 89 |
| Roughage | 7,258 | 7,498 | 7,465 |
| Butterfat | 329 | 332 | 253 |
| Prices per pound (cents) | | | |
| Concentrates | 1.472 | 0.763 | 1.304 |
| Roughage | .629 | .454 | .506 |
| Butterfat | .532 | .271 | .364 |
| Returns over feed | | | |
| 1928-30 prices | **$90.35** | $86.93 | $84.59 |
| 1931-33 prices | 33.87 | **33.31** | 31.90 |
| 1934-36 prices | 50.86 | 49.77 | **53.10** |

During the years 1931 to 1933 the prices of both feed and dairy products were low, but he still maintained his high rate of feeding, and while his return over feed was much lower than in previous years, it was greater than if he had fed at a reduced rate. By 1934 the price of concentrates had risen sharply, the price of roughages had risen but little, and only a moderate increase in the price of butterfat had occurred. A careful study of his past records convinced this farmer that the high rate of concentrate feeding would not pay in view of the changed price relationships. He eliminated practically all concentrate feeding but maintained his roughage feeding at the previous level. His production dropped sharply, but his return over feed was greater than if he had maintained his former production by heavy concentrate feeding, and he had the grain thus saved available for feeding hogs and poultry which used this feed to better advantage at the prices then prevailing.

The returns over feed per cow for each of the three levels of feeding and each of the three levels of dairy product prices are shown. The figure in bold type was the actual return for the period and the other two figures are the returns that would have been obtained at prevailing prices if the rates of feeding of the other two periods had prevailed. This dairyman was obviously quite successful in adjusting his rate of feeding to changing price levels and, according to his own statement, used his records as a basis for determining his rate of feeding.

These are but a few illustrations of the way that individual farmers use farm records as a guide to profitable production practices and policies. No two farms, no two farmers, and no two dairy herds are exactly alike. Each has its individual problems. A study such as this brings out some general principles of success and illustrates the general effect of certain factors on production and returns. The factors that operate generally on a group of farms are likely to be significant on the individual farm, but their significance varies widely among different farms. The dairyman who has records of his own herd for study and comparison with the results of other dairymen operating under similar conditions is best able to see opportunities for improving his practices and keeping adjusted to changing price relationships.

These illustrations of profitable dairy practices and the use of farm accounts in increasing returns from the dairy herd are also valuable for agricultural extension purposes and may be very useful to other farmers not keeping records of their dairy costs and returns. The practices that have proven profitable on these farms and the increase in returns resulting from their adoption are in most cases of general application. The basic data on dairy production presented in this study may be used in computing the returns from dairy production under a wide variety of different price relationships for feed and dairy products. The farmer who has his own records for comparison is not only in the most favorable position to use this material effectively, but will be most likely to keep his dairy operations most closely adjusted to changing economic conditions.